

REMARKS/ARGUMENTS

In response to the Office Action mailed May 16, 2006, Applicants request reconsideration based upon the following remarks. No claims are added or cancelled and no claims are amended. Accordingly, claims 1-19 remain pending. For the convenience of the Examiner, a copy of the claims pending in this patent application is attached. The claims have not been amended since the filing of the response to the first Office Action on June 28, 2005 and may be somewhat difficult to locate.

Applicants express gratitude for the clarification of the commentary appearing in the Office Action mailed December 22, 2005. However, there are still a few ambiguities. While the Office Action mailed May 16, 2006 states that claims 1-19 are rejected, there is no specific rejection of claim 11. It is presumed that if claim 2, from which claim 11 depends, is not allowed, that the next Office Action will specify the basis of the rejection of claim 11. Since claims 12-14 depend directly or indirectly from claim 11, for the purposes of this response, it has been assumed that claim 11 was rejected on the same basis that claims 12-14 were rejected.

The Examiner explained in the Office Action of May 16, 2006, that the rejections based upon the Wang reference were withdrawn. Therefore, it is considered that the first paragraph appearing at page 4 of the Office Action intended to refer to Lee and Robinson rather than Wang and Savas.

The invention as described in independent claim 1, the only pending independent claim, relates to a method of manufacturing a semiconductor device. More specifically, the invention relates to the manufacturing of a via hole extending through a series of films and to a conductive layer in a substrate. The conductive layer and the substrate are first covered by a stopper film, on which an interlayer insulating film is then deposited. Then, a capping film is deposited on the interlayer insulating film.

In order to form the via hole, a photoresist film having a particular pattern is formed on the capping film. Then, using the resist film as a mask, the capping film

and the interlayer insulating film are etched to form an opening that extends through those two films to the stopper film. The etchant employed does not etch the stopper film, providing the basis for identifying that film as a stopper film.

An important feature of the invention appears in the final steps of claim 1. In the claimed process, the resist film is left in place, **after** etching the capping film and the interlayer insulating film, and a different etchant is employed to etch the exposed part of the stopper film to complete the via hole. Only **after** etching the stopper film is the resist film removed in an ashing process.

Claims 1-3, 7-10, and 15-19 were rejected as obvious over Lee et al. (U.S. Patent 6,815,331, hereinafter Lee) in view of Robinson et al. (U.S. Patent 4,201,579, hereinafter Robinson) and further in view of Robb (U.S. Patent 4,529,860). This rejection is also respectfully traversed.

Claims 4-6 and 11-14 were rejected as unpatentable over Lee in view of Robinson and Robb, and further in view of a description appearing in the IBM Technical Disclosure Bulletin (hereinafter IBM TDB). This rejection is respectfully traversed.

Of the four publications applied in rejecting the pending claims, only Lee was relied upon as allegedly disclosing the basic elements of claim 1, the sole pending independent claim. Applicants emphasize that, in the invention, after etching the capping film and the interlayer insulating film, using the resist film as a mask and exposing the stopper film, the resist film is left in place while the exposed part of the stopper film is removed by etching. Applicants further emphasize that only **after** etching of the stopper film, not before etching the stopper film, is the resist film removed by ashing. This important feature of the invention, described above, namely leaving the resist film in place until after etching the stopper layer, has not been addressed in the comments of the most recent two Office Actions. Applicants are concerned that this important feature of the invention may have been overlooked and now respectfully request that this feature be given attention. If this feature does not distinguish from the prior art, then Applicants respectfully request a detailed

explanation of where this feature is found in the prior art applied in rejecting claim 1. According to Applicants' analysis, this feature is not shown in any of the publications applied in rejecting the claims.

The principal reference, Lee, never discloses leaving the resist film in place during etching of the stopper layer. In applying Lee, attention was directed to Lee's Figure 37. That Figure 37 is the first figure in a series of figures in Lee describing forming of a via hole. The description of the Lee process that appears in the Office Action is entirely consistent with the disclosure of Lee regarding Figures 37-39. That description appears in columns 15 and 16 of Lee. In Figure 37, as identified in the Office Action, the resist mask is element 710. Applicants agree that the layers 704, 706, and 708 of Figure 37 can be compared to the stopper film, the interlayer insulating film, and the capping film, respectively, of the claimed invention.

The comparison of Lee to claim 1 in the Office Action is erroneous, however, because Lee expressly describes, in column 16, lines 32-34, removing the photoresist pattern 710 by ashing **before** etching and removing the stopper film 704. In fact, in Lee, numerous steps are carried out after removing the photoresist pattern 710 and before removing any part of the stopper film 704 to produce the structure shown in Figure 43 of Lee. Thus, Lee fails to supply an important part of the invention that has been emphasized not only in independent claim 1, but also in the previous responses.

Robinson and Robb are both directed to techniques of etching or removing photoresist or like materials and include no relevant disclosure with regard to leaving in place a photoresist mask while the stopper film within an opening, defined by the photoresist mask, is removed. Further, IBM TDB is only related to particular ashing techniques and does not contribute any potentially relevant teaching that could be employed to modify Lee and suggest the invention as defined by claim 1.

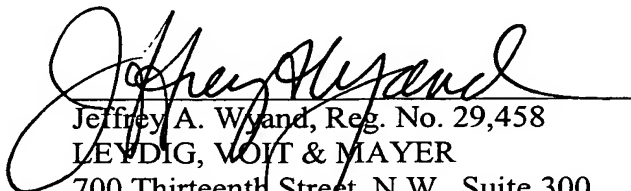
As already pointed out, in the invention as claimed, the original resist film is left in place even after the etching of the interlayer insulating film. That original resist film is used in etching the stopper film to complete the formation of the via hole. As described in the patent application, particularly with respect to Figure 7C, if the resist

film is removed early, then the via hole becomes undesirably enlarged in area and tapered in cross-sectional shape. This result occurs because the etchant, in etching the stopper film, etches not only the stopper film but also any part of the capping film that is exposed. Any part of the capping film from which the resist has been removed is exposed and is etched as is the interlayer insulating film. The natural result is a tapered via hole. The tapering is avoided in the invention by leaving the resist film in place until after the stopper layer has been etched. In other words, the continued presence of the resist film is not merely accidental or unrelated to the result that is achieved. The presence of the resist film is important to control the shape of the via hole. No such resist film or mask of any kind is present in Lee in any step after exposure of the stopper film.

In order to demonstrate *prima facie* obviousness of a claim, it is critical that all of the elements of the claim be shown to be present in the prior art. If all of the elements of a claim are present in the prior art, then it is also critical to demonstrate that one of skill in the art would combine the elements as in the claimed invention in order to show that the invention is obvious and not patentable. Here, the first of these two essential requirements is missing so that the second requirement cannot even be considered. Lee, like the prior art described in the patent application, removes the photoresist before the etching of the stopper layer. Since none of Lee, Robinson, or Robb, much less IBM TDB, describes an important feature of all pending claims, *prima facie* obviousness of claim 1 and of its dependent claims 2-19, has still not been established.

Because the rejection of claim 1 is deficient, Applicants respectfully request reconsideration and allowance of that claim 1 and of all of claims 2-19, since those claims all depend directly or indirectly from claim 1.

Respectfully submitted,


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